

Technology Development and Verification by the Diagnostic Instrumentation and Analysis Laboratory at Mississippi State University

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Abstract

The Diagnostic Instrumentation and Analysis Laboratory at Mississippi State University was originally established twenty years ago to develop diagnostic tools for the Department of Energy's magnetohydrodynamic program. Since 1993, DIAL has been assisting the Department of Energy's Environmental Management (EM) program by developing advanced sensing and monitoring systems, and applying these capabilities in the field.

Recently, DIAL's mission has been expanded to include verification of the performance of technologies for environmental remediation. The following exemplify the range of DIAL's capabilities in technology development and performance testing.

- The LIBS (Laser-Induced Breakdown Spectroscopy) system is a versatile monitoring tool which can be used to monitor air emissions from government and industrial processes. It has recently been miniaturized, and is readily deployed in the field. The same system is currently being modified so that it can be used to verify the content of special nuclear materials (e.g. plutonium) in either spent nuclear fuel or various waste forms. Currently, there is no instrument developed for this type of verification, so LIBS is filling a critical need.
- The plasma electrode health system is combined hardware and software solution to the problem of the short life of the electrodes in plasma torches. Plasma torches have the potential to be tremendously useful tools for immobilizing some of the government's most difficult-to-handle wastes (e.g. DOE's heterogeneous mixed wastes). In a properly designed melter, the plasma heats even very non-uniform wastes to temperatures high enough to achieve a uniform and stable solid, with a volume reduction in excess of 95%. However, realization of plasma's potential has been slowed by the short life of the plasma electrodes. DIAL's electrode health system "senses" the state of the electrode (for example, if too much heat is being generated in one spot) and signals the operator to change operating conditions to extend electrode life. Extended testing have shown improvements of 3 - 6X in electrode life.

- The “drum thunker” is a low tech solution to a very high tech problem. Drums of stored hazardous waste, particularly radioactive waste, can generate gases (e.g. hydrogen) in the top of the drums and pressurize. Occasionally, explosions have resulted when such drums have been opened. Using the DIAL system, an operator can simply tap the top of a drum, and by monitoring the frequency of the vibration, determine whether or not special precautions must be taken. DIAL has combined these acoustic techniques with its laser technology to develop innovative instrumentation for monitoring the viscosity and specific gravity of viscous liquids (glasses or slurries).
- DIAL has developed very flexible test facilities able to determine the performance of a wide variety of environmental technologies. These include air pollution control devices and systems, continuous emissions monitoring instrumentation, and other specialized equipment for environmental remediation.
- Along with its superlative instrumentation capabilities, DIAL has also developed the ability to rapidly deploy this instrumentation in the field quickly and inexpensively. One of DIAL’s unique features is its ability to bridge the gap between research and reality by taking its advanced instrumentation whenever it is needed. DIAL has deployed its instrumentation at the Idaho Chemical Processing Plant, the Savannah River Site, and several other locations to meet users’ needs. As a result, these sites have not had to permanently acquire the same diagnostic capabilities, and have been able to use their scarce resources to fill other needs. This also allowed DIAL to make use of the testing facilities at these sites, and thus avoid their costly replication. As a result, DIAL can perform its verification function for virtually any technology needed by DOE EM.

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